United States
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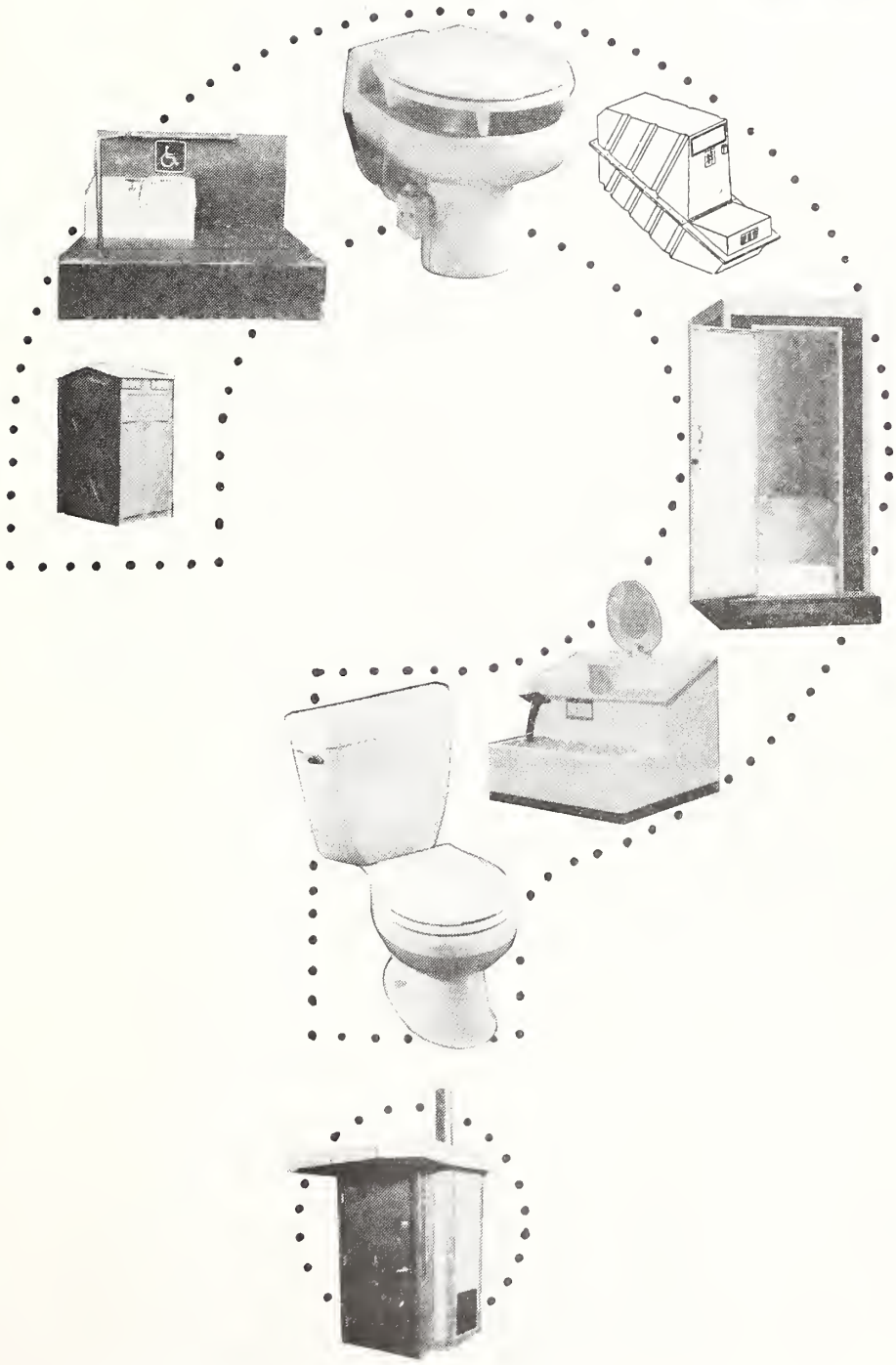
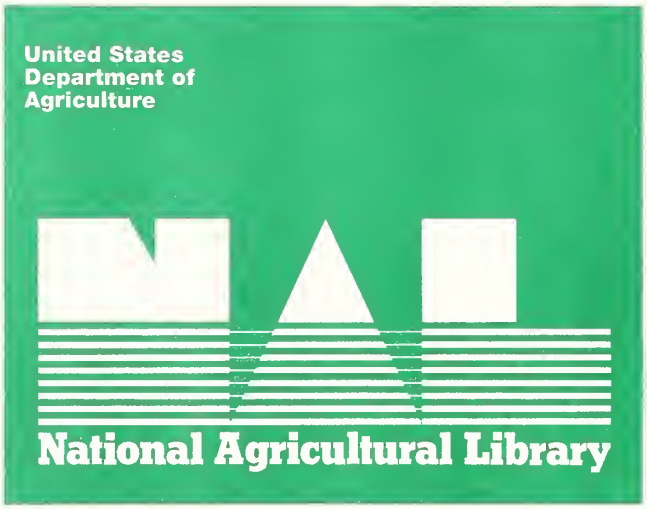
2300—Recreation
April 1991
9123 1204

Guidelines for the Selection of a Toilet Facility

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Guidelines for the Selection of a Toilet Facility

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INTRODUCTION

The objective of this publication is to stimulate a thought process within a recreation site planner/designer so that he/she will be better equipped to select the appropriate toilet facility to match the site conditions, maintenance skills, and waste disposal alternatives available.

The author suggests that anyone who is in the process of designing a toilet facility should include the maintenance personnel in the decision-making process. This will insure inclusion of maintenance considerations in the design and will help commitment to the proper installation, maintenance, and operation of the selected system.

The most important parameter to be considered is customer satisfaction. All of the cost and labor associated with the construction of the selected system is wasted if the end product is not accepted by the customer.

This publication will address the following types of toilet facilities: water-flush, low volume water-flush, compost, chemical recirculating, chemical, vault, and pit toilets.

PLANNING CONSIDERATIONS

Some initial items to consider when planning a toilet facility are:

1. How many people will the facility serve?

2. Is water available at an appropriate quality, quantity, and pressure for water supply and/or flush toilets?

3. Quality of water is very important. Samples should be taken in advance so that treatment processes, if necessary, will be known. Do not design the water system until the quality, quantity, and pressure are known.

4. If you select a flush toilet system and a typical subsurface disposal system is your only alternative, before designing the system, get percolation tests and local approval.

Evapotranspiration beds/trenches are also possible but are more expensive. Contact Engineering for design of ET beds/trenches.

5. If limited water is available:

a. Perhaps there is enough for low volume water toilets.

b. Perhaps there is only enough for sinks, water fountains, and maintenance used in conjunction with non-waterborne toilet facilities.

6. If the quality of the water is poor, it may still be adequate for flush toilets only. Do not use water with staining qualities because of the adverse maintenance characteristics.

7. Are sewage pumping companies or individuals available in the local area for servicing vault and chemical toilets? What type of equipment do they have and do they understand that we require the removal of all debris, rocks, cans, bottles, etc.? What is the present and future cost of this service? What is the hauling distance to an approved disposal site?

8. Are treatment facilities or landfills available to dispose of the waste from pumping low volume water flush, chemical, or vault toilets, or removing waste from compost toilets? What is the hauling distance to an approved site? Are the changes in water quality control acts/legislation going to affect the long term acceptance of this waste at currently approved disposal sites? Local regulations need to be followed.

9. Are climatic conditions acceptable for the type of system selected? Examples:

a. Compost toilets do not work as well in very humid or very cold climates (additional tanks are required).

b. Photovoltaic (solar) panels needed to operate fans, etc., do not function well in overcast areas.

c. Waterborne systems cannot be used in freezing areas without protection or supplemental heating.

10. Is the location of the facility in a flood plain? Flood zones require special design considerations to prevent contamination. Local regulations must be followed.

11. How will waste be disposed of in backcountry areas inaccessible to vehicles?

12. Have you considered accessibility for people with disabilities? All toilet facilities should be designed for people with disabilities.

13. Consider construction cost versus maintenance cost. Low construction cost that requires high maintenance cost does not make much sense and will likely reduce customer satisfaction.

14. If the use at any site is minimal, perhaps one toilet for both sexes will be adequate and acceptable.

Although the objective of this publication is not to enter the design arena of any system, the author feels compelled to mention one design item that continues to be overlooked—slope to provide proper drainage.

Consider how often water is found standing in puddles on concrete floors in toilet facilities. Because contractors cannot be that precise when working small areas with concrete, do not use conventional concrete floor slopes of 1/4 in per foot. Use a 1/2 in per foot slope. This slope will provide adequate drainage and still meets the requirements for accessible facilities. Good sloping is particularly important in very wet areas to help prevent standing water which results from the users bringing it in on their feet.

It is very important that the site planner/designer personally contact the personnel who will be responsible for the operation and maintenance of the proposed system. You should know in advance that the system will be accepted by the maintenance personnel and will incorporate maintenance needs such as coved edges, rounded corners, sloped and skid resistant floors, etc.

WATER-FLUSH TOILETS

GENERAL

Whenever possible, flush toilets should be used. The customers are requesting flush toilets more frequently than in the past. There is a definite trend away from primitive site facilities and this trend is expected to continue.

DESCRIPTION

Water-flush toilets are usually composed of vitreous china or stainless steel. A water trap is maintained and the toilets are flushed by a gravity-fed holding tank or a pressure valve (no tank required). The holding tank is attached to the back of the toilet or mounted behind the wall.

MAINTENANCE CHARACTERISTICS

The maintenance of flush toilets is widely known and parts are readily available. Stocking of parts, other than whole toilets for vandalism replacement, is generally not necessary due to their availability.

Flush valve maintenance requires a minimal amount of training. A Forest should use the same type of flush valve so that parts and maintenance are not a problem. Parts can be more easily stocked if all of the flush valves used are the same.

If flush valves are used, the water supply must be free of sand particles. Sand or other foreign material in the water prevents proper sealing of the valve, resulting in a loss of water.

Flush toilets are one of the easiest toilets to clean because of the vitreous china or stainless steel in conjunction with the available water. A standard toilet brush is adequate for cleaning the toilet bowl. Sponges and disinfectant can be used on the seat and on the outside surface of the toilet.

If the flush tanks are placed behind the wall, the employee does not have to include them in the daily maintenance schedule and vandalism to the tanks is eliminated.

Personnel do not object, for the most part, to cleaning flush toilets because they are the most widely accepted toilet system. Adequate training and maintaining a stock of spare parts is necessary.

If it is necessary to utilize a sewage lift station, then maintenance costs will increase considerably.

TREATMENT OF SEWAGE

Treatment of the sewage can be accomplished by using:

1. A septic tank-leach field.
2. An evapotranspiration bed/trench.
3. Connecting to a municipal system.
4. Or, if the system is large enough, connecting to an on-site treatment plant.
5. Large holding tanks are possible but ***ABSOLUTELY NOT RECOMMENDED!***

CUSTOMER ACCEPTANCE

The customers rarely complain about flush toilets unless the facility is not kept clean. If you have designed flush toilets for any given area, the customer will seldom request a different system. Flush toilets are not always feasible to install for a number of reasons, including temperature and the lack of an adequate water supply.

COST

The cost of standard flush toilets is in the $100 to $200 range.

The cost of stainless steel wall-mounted flush toilets with wall-mounted push button valves is approximately $375 to $480.

The cost of a septic tank leach field is contingent on a number of variables. It depends on the size of the facility to be treated, the distance from the building to the leach field, and the material of the

ground to be excavated. Typically, for a four-unit building in a campground the cost of the septic-tank leach field might run between $3,000 and $4,000.

The cost of the water system depends on too many variables to provide an estimate.

The cost of connecting to a municipal sewage system depends on the hookup charge imposed by the municipality and the distance to the connection from the toilet facility.

Lift station costs will not be given here due to their extreme variability.

ADVANTAGES

1. The toilet fixtures are readily available in a variety of styles.

2. Replacement parts are also readily available.

3. Reliability of water-flush toilets is excellent.

4. The customer is familiar with the operation and readily accepts and wants flush toilets. Less complaints are received from the customer than with any other system.

5. The volume of water provided is effective in removing the majority of the waste from the bowl.

6. Employees complain less about cleaning flush toilets than any other system.

DISADVANTAGES

1. Flush tanks and bowls are easily vandalized, although such vandalism is uncommon. To prevent the temptation of vandalism in public areas, consider using concealed flush valves. This will greatly reduce the vandalism and create less maintenance.

2. Regular flush toilets use 4 to 7 gal of water. This requires an adequate water supply and an adequate waste disposal area. The author recommends that the new 1.6 gal low-water flush systems be used in order to conserve water.

3. Flush toilets cannot be used in freezing areas unless protection or supplemental heating is designed into the installation.

4. If only one toilet fixture is installed for men and one for women and one of the two clogs up, then there is no facility available for one of the sexes. Consider a minimum of two fixtures per side unless you plan to offer unisex facilities.

LOW-VOLUME, WATER-FLUSH TOILETS

GENERAL

Low-volume, water-flush toilets offer the advantages of using considerably less water than a conventional flush toilet. ***HOWEVER, THERE IS A MAJOR CAUTION HERE!*** Experience has clearly shown that when less than 1 gal of water per flush is used, the fecal matter is not completely removed from the bowl. Consequently, the customer will often flush the system numerous times to try and remove the waste, thus eliminating the water savings.

DESCRIPTION

In the past, low-volume toilets looked considerably different than standard flush toilets. Some still do. Recently, some counties (Los Angeles for one) and seven entire states have enacted legislation that requires all toilets to use only 1.6 gal of water. So now the flush toilets using between 1.0 and 1.6 gal per flush look very much like the standard 5 gal per flush toilets and are hydraulically designed to flush with less water.

Typical flush tank low-volume water-flush toilet.

Low-volume toilets that do not incorporate a water trap are the ones that look different. Some incorporate a foot pedal for flushing. The foot pedal activates a flapper, slider, or ball valve for removing the waste. A small amount of water is retained above the various valves to help keep the bowl clean. Additional water is added when the foot pedal is depressed. One system requires compressed air to remove the waste after dropping into a compartment through a flapper valve.

Raised seat on low-volume water-flush toilet for persons with disabilities.

It is suggested that when selecting low-volume, water-flush toilets, the new 1.0- to 1.6-gal models using conventional water traps be used. Where the predominant use is for urine, such as beach or picnic areas, then the fixtures using less than 1 gal may be appropriate.

MAINTENANCE CHARACTERISTICS

The new 1.0- to 1.6-gal low-volume flush toilets are designed exactly like the standard flush toilets so the maintenance is also the same. Internal parts are virtually the same and easily obtained.

If the low-volume flush toilets are the kind with the foot pedal and either the flapper, slider, or ball valve, then the maintenance is completely different and special training is necessary. Parts will need to be stocked because they are not available except from the manufacturer. Experience will soon tell you what parts and how many need to be stocked. The same manufacturer's fixture should be used throughout the Forest if below the 1.0- to 1.6-gal per flush level. Using the same fixture will reduce maintenance costs and maintenance personnel can become familiar with the toilets.

The low-volume flush toilets using less than 1 gal of water will result in more fecal smear on the back of the bowl and will require more frequent cleaning.

If low-volume, water-flush toilets are used to retrofit a vault and no leach lines are attached, then you need to consider the availability of local pumping companies and the cost of pumping and hauling. If a valve sticks open, the vault may fill up in one day or less.

TREATMENT OF SEWAGE

Treatment of the sewage can be accomplished in the same way as standard flush toilets. The major difference is that by using less water, the sewage pipe sizes and slopes have to be carefully designed to prevent clogging.

If on-site treatment plants are used, then remember that the Biochemical Oxygen Demand (BOD) will be greater than normal flush toilets because of the reduction of water.

NOTE: Never use a low-volume or standard flush toilet over an existing vault unless all other options are examined. Then plan on frequent pumping.

CUSTOMER ACCEPTANCE

The customer likes nearly any form of flush toilet. The major complaint will be from the increased fecal smear resulting from too little water to adequately rinse away the waste. When less than one gal of water is used, there is not enough water to completely remove the waste.

Since the new 1.6-gal toilets look exactly like the conventional 5-gal toilet, the public will not know the difference. Acceptance will be the same.

COST

The costs range from $150 to $700. Remember that the more conventional toilets will cost less in maintenance than the ones that use nonconventional parts or the ones that are imported. Costs for septic tank and drainfield disposal are similar to flush systems. Some cost savings will occur due to smaller leach fields because of less water being used per person.

If a holding tank is used under the low-volume water-flush toilet, the cost for each pumping should be less than for vault toilets because there is little to no debris that needs to be removed. The cost of hauling from low-volume water-flush toilet installations will be higher than those from vault toilet locations, because more trips will be required.

The cost for pumping and hauling are entirely dependent on the volume of waste, the cost for the hauler to dispose of the waste, and the distance to the disposal area. These costs need to be evaluated before the toilet facility is selected.

ADVANTAGES

1. Low-volume fixtures use between 0.25 and 1.6-gal per flush.

2. No external plumbing is required assuming a vault is used directly below the toilet.

3. Existing vault toilets can be easily retrofitted.

4. Virtually no trash such as rocks, cans, bottles, etc. is thrown into the vault because of the small openings and/or water traps associated with low-volume fixtures.

5. Pumping is easier than a vault toilet because of the absence of trash. An exterior pump-out pipe can be installed for easy removal of the waste.

6. Odor problems within the building are mostly eliminated due to the water seal and/or flapper valve closure.

7. Public acceptance is good, except when fixtures are used that utilize less than 1.0 gal per flush, resulting in fecal matter collecting on the bowl.

DISADVANTAGES

1. Maintenance is increased where less than one gal systems are used and for systems using the non-standard water trap system due to the increased fecal smear.

2. Parts are not as readily available as with standard flush systems. An inventory of parts should be kept in reserve along with spare toilets.

3. The non-conventional nature and shape of some low-volume systems and exposed flush tanks draw public attention to them and increase vandalism.

4. If vaults are used under or adjacent to the low-volume toilets, to totally contain the waste, pumping is required more frequently than a standard vault toilet and can be very frequent if water is allowed to continuously flow due to improperly operating toilets. However, pumping is easier due to the lack of trash. Vaults can be equipped with 4 to 6-in pumpout pipes plumbed with quick disconnects to the outside of the building. Check local pumper attachments for continuity.

5. Odors can be emitted within the toilet building if non-trap type low-volume toilets are used. As you depress the foot pedal and a flapper or slider valve opens to discharge the waste, odors can be admitted into the building. Proper venting will reduce this problem. In certain locations such as low-lying areas, hollows, and areas subject to temperature inversions etc., odors can be emitted from the waste containers (vaults) and through the vent pipe and cause odor problems outside the building.

6. If septic tanks are placed adjacent to the building, remember that there is very little water to carry the waste when low-volume fixtures are used, so follow manufacturers' recommendations regarding distance from the toilet fixture to the septic tank and the slope of the sewer line.

7. Waterborne systems cannot be used in freezing areas unless protection from freezing is designed into the facility.

COMPOST TOILETS

GENERAL

The decomposition or stabilization of organic matter by biological action has been taking place in nature since life first appeared on our planet. In recent times, man has attempted to control and directly utilize the process for sanitary disposal and reclamation of organic waste material. This process has been termed "composting" and the final product of composting has been called "compost".

When organic material is decomposed in the presence of oxygen, the process is called "aerobic". In aerobic stabilization, living organisms which utilize oxygen, feed upon the organic matter and develop cell protoplasm from the nitrogen, phosphorus, some of the carbon, and other required nutrients. Much of the carbon serves as a source of energy for the organisms and is burned up and respired as carbon dioxide (CO_2). Since carbon serves both as a source of energy and as an element in the cell protoplasm, much more carbon than nitrogen is needed. This is why it is necessary to add wood shavings (a carbon source) to the fecal matter on a regular basis. It is also *EXTREMELY IMPORTANT* to thoroughly mix the fecal matter with the added wood shavings so that there is a good contact between the fecal matter and the wood shavings.

If, however, the ratio of carbon to nitrogen in organic materials being decomposed becomes excessive, biological activity diminishes and several cycles of organisms may be required to burn up most of the carbon. The large container and long retention time designed into the compost systems helps to alleviate this problem.

With a small amount of training, maintenance personnel will soon learn the correct amount of wood shavings to add versus the amount of fecal matter present. Door counters on the entrance doors can be used as a guide also. Remember that decomposition in compost toilets is in the mesophyllic range or low temperature range, so it takes time to decompose. That is another reason that the compost container is large in size.

When designing the building and underground vault to contain the compost toilet, *DO NOT INSTALL A VERTICAL LADDER FOR ACCESS.* Include a stairway in the building design so that maintenance personnel can easily enter. Also provide adequate room for maintenance.

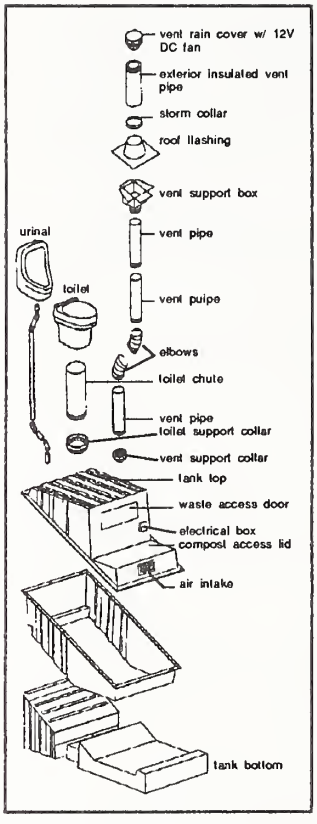
During the past 18 years, the main supplier for compost toilets has continuously improved the process and has many successful installations. Compost toilets can be used in most places that vaults are used and in most places where vehicle access is not possible. Fans for supplying air to the compost are necessary and must run 24 hours per day. Where electricity is not available, solar powered fans are required.

The development of solar panels and storage batteries have advanced to a practical state and require very little maintenance. The solar panels are also extremely vandal resistant.

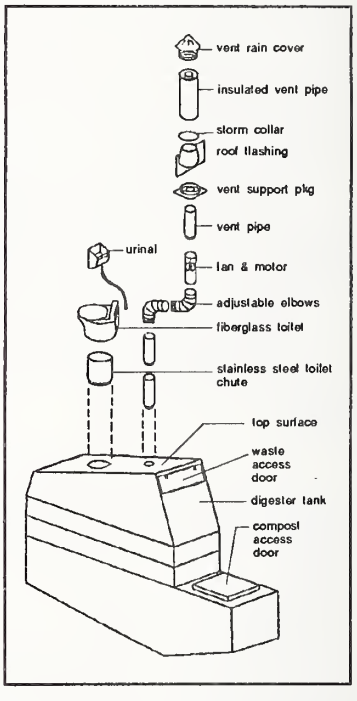
The major design factor to consider here is how much use the compost toilet receives. The manufacturer's direction must be followed. The biggest problem encountered to date is overloading the compost system. Remember that in humid and cold-climate areas, more compost containers are necessary for the same number of users than in dry areas.

DESCRIPTION

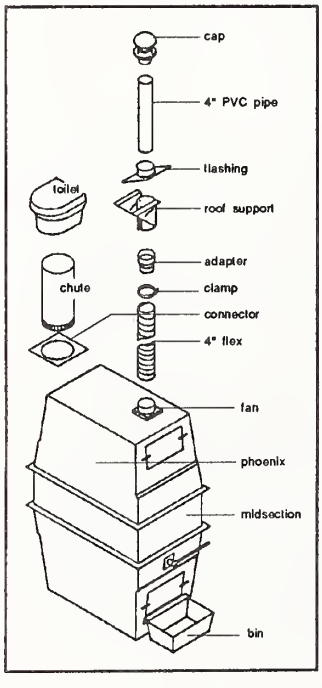
There are three major producers of compost toilets:



Clivus Multrum
21 Canal St.
Lawrence, MA 01840-1801
508/794-1700



Composting Toilet Systems (CTS)
Route 2
Newport, WA 99156-9608
509/447-3708



Advanced Composting Systems (Phoenix)
195 Meadows Rd.
Whitefish, MT 59937
406/862-3854

The Clivus and Phoenix units are made out of cross-linked polyethylene and the CTS product is made out of fiberglass. The Phoenix and CTS units have a daily capacity of between 70 and 100 uses per day. Clivus has systems that range from 50 to 180 uses per day. Climatic conditions must be taken into account when establishing design criteria. Different building designs must be considered for flat versus sloping ground.

MAINTENANCE CHARACTERISTICS

Cleaning the toilet riser and the building interior is the same as a vault or pit-type toilet.

The waste material in the compost container (fecal, urine, and toilet paper) must be thoroughly mixed with both the existing and added wood shavings or other carbon source material agreed upon with the manufacturer of the compost system. Approximately 1 gal of wood shavings per 100 uses should be added. Mixing should occur at approximately 200 to 300 uses or once a week, whichever occurs first.

During the mixing process, the maintenance person is in a relatively odor-free position. When the access door is opened, the fan draws its air in through this opening and therefore no odor comes out.
Inorganic material (cans, bottles, plastics, etc.) should be removed on a regular basis. This debris should go to an approved landfill.

Periodic removal of the final compost material is dependent on too many factors (use, climatic conditions, etc.) to give a volume or time period estimate. ***Many well used and properly operated public systems have not had any solids removed in over seven years.***

Employees should take the normal precautions when handling human waste. Rubber gloves should be worn and normal shots should be taken. Consult local physician.

If solar power is used for the fan, periodic maintenance of the panel (cleaning), the battery, and the fan will be needed.

TREATMENT OF SEWAGE

An extensive evaluation of the final waste product from the Clivus Multrum compost toilets by H. Wayne Nichols at the Center for Biology of Natural Systems, Washington University in St. Louis, Missouri concluded: "The bacterial composition of the final multrum product is similar to that of soil. The pathogenic potential of the final multrum product, i.e., the numbers and species of pathogenic bacteria present, is similar to that of soil. The multrum final product appears to be suitable for use as a soil amendment."

Please note that these results are from Clivus Multrum systems only and not from the Phoenix or CTS systems.

If all manufacturers' directions are followed and all systems are operated correctly, there is no reason to believe that the results would not be the same for all three systems.

There are two waste products that we must deal with; liquid and solids. ***All*** systems should make provisions to take care of excess liquid and you should never rely on evaporation alone. The easiest way to take care of the liquid is to drain it by gravity to a small leach field, if the area allows for it. The solids must be removed by using a small shovel and can be either bagged and sent to an approved landfill or buried within the top six to eight inches of the ground surface. The use of compost waste products is ***not recommended*** for above ground mulch or fertilizer.

CUSTOMER ACCEPTANCE

When given the choice between previously designed vault toilets and compost toilets, the public appreciates the reduced odor associated with the compost toilets. Many visitors have been known to thank Forest Service personnel for the better toilet facilities in campgrounds with compost systems.

The odors emitted from a compost system are considerably less than from a vault or pit-type toilet, so there is less chance of creating offensive odors in the area around the toilet.

COST

The current cost of the three major Compost Systems in alphabetical order is:

1. Advanced Composting Systems (Phoenix)

Model P.F. 200
(5 ft long by 3 ft wide by 6 ft high) = $4,500
Model P.F. 201
(5 ft long by 3 ft wide by 7.5 ft high) = $5,000

2. Clivus Multrum Inc. (Clivus)

Model 202u
(9.7 ft long by 3.25 ft wide by 5 ft high) = $5,350
Model 202m
(9.7 ft long by 3.25 ft wide by 5 ft high) = $5,500
Model 205
(9.7 ft long by 3.25 ft wide by 7.7 ft high) = $5,500
Model M-22 Vessel = $8,550
Model M-25 Vessel = $9,000
Model M-32 Vessel = $9,450

Model M-35 Vessel = $9,950
Model M-22FT Low-Flush Vessel = $9,280
Model M-25HL High-Liquid Vessel = $9,650
Model M-22LC Large-Capacity Vessel = $9,650

3. Composting Toilet Systems (C.T.S.)

Model CTS 10-10
(9 ft long by 4 ft wide by 8 ft tall) = $4,396
Model CTS 904
(9 ft long by 5 ft wide by 5 ft tall) = $5,575

All of the above costs for the compost toilets are for the compost container alone and do not reflect the cost of the building or installation.

ADVANTAGES

1. Compost toilets are predominately odor free during use due to the fan system and the aerobic conditions of the waste.

2. In warm climatic zones, the systems can receive the maximum design use per day. This use can be averaged out over the week with more on the weekend and less during the week.

NOTE: If 100 people remain all day in the area, this can result in 350 to 400 uses per day

3. Customer satisfaction is good.

4. Properly sized and operated systems may not have waste material (compost) removed for years.

5. Odors blown out of the building, by the fan, are much less evident than from a vault or pit toilet due to the aerobic nature of the compost and the liquid separation.

DISADVANTAGES

1. Although the compost systems are odor free in the use compartment, the waste pile is still visible through the toilet riser. Aesthetically, this is still not pleasing to the customer. Locate interior lighting or skylight to help obscure the view of the waste.

2. Compost systems are restricted to certain capacities due to the biological process of degradation and they must not be overloaded.

3. The compost containers are relatively large and, therefore, require a large housing under the building. The containers are not designed to be buried directly in the ground.

4. Maintaining the system is not difficult, but does take training and, above all, interest on the part of the maintenance person.

5. When the final compost material is removed, it can either be shallow buried (6 to 8 in) or taken to an approved landfill. Always use caution when handling waste material. Rubber gloves should be worn.

6. Arrangements for liquid removal should be made during the design process. Do not rely on evaporation alone. A small leach field (check local sanitary requirements), a small hand pump or D.C. pump to a leach field or holding container, or a combination of methods must be considered.

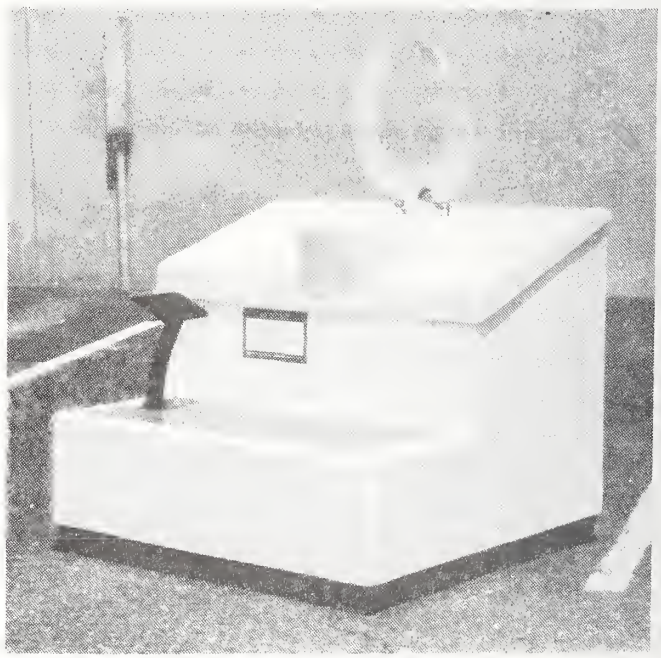
CHEMICAL-RECIRCULATING TOILETS

GENERAL

Chemical-recirculating toilets are predominately used as temporary facilities. However, the individual toilet fixtures can be purchased separately and installed in standard buildings. Generally, when this is done, a separate large vault is placed under the building and the individual recirculating toilets are emptied into this vault. This reduces the frequency of pumping.

DESCRIPTION

Chemical-recirculating toilets usually have between a 50 to a 100-gal tank precharged with a few gallons of water and chemical. Some form of flushing mechanism uses this precharged water, chemical, and added waste to flush the toilet bowl. During each flush a small amount of fresh chemical is injected into the flush media to keep the chemical/waste ratio correct for adequate disinfec-



Chemical-recirculating toilet.

tion. The chemical is necessary because the liquid being flushed is a mixture of fecal matter, urine, water, and chemical. So for public safety reasons, some form of disinfectant is necessary. The customer cannot see the waste in the holding tank because there is a flapper valve at the bottom of the bowl.

Chemical-recirculating toilet and building.

Normally there is a color associated with the chemical. Blue is common. This color is introduced so that the user's view is obscured from seeing the small waste particles. Remember that the liquid being flushed is a mixture of the precharged water, the chemical, and the waste.

Odors within the use compartment can be virtually eliminated by proper venting (either static or dynamic). The same principles as those used in the proper venting of vault toilets should be used.

Designs for complete accessible chemical recirculating toilet facilities will be available in early 1991 from Monogram Industries, Compton, CA.

Chemical-recirculating toilet for persons with disabilities.

MAINTENANCE CHARACTERISTICS

Chemical recirculating toilets do not remove the fecal matter as well as a flush toilet on the first flush but frequent flushing does work and no additional water is used. The public will often leave before the fecal smear is completely removed so maintenance personnel can expect more frequent cleaning. The major maintenance requirements are keeping the internal parts operating. It is not difficult, but training is necessary. Spare parts are a must in order to reduce downtime, and these parts must be ordered from the manufacturer.

Pumping these systems can be accomplished down from the top (the cover on some lift up) or from an opening in the back. Another option is to install the chemical recirculating container over a larger vault and when it is time to empty the chemical recirculating container simply discharge the waste into the vault below. The larger vault is then pumped when it fills up. Problems occur when the public puts inorganic material into the toilet which is large enough to clog the opening leading to the vault.

For use and frequency of pumping purposes, a good figure to remember is that it takes 1,500 average uses to fill a 100-gal tank.

Normal precautions should be taken when handling concentrated waste material.

TREATMENT OF SEWAGE

When considering this system, first find a source for treating or accepting the waste. Disposal of this form of concentrated sewage is becoming more difficult because of the chemicals being used and the increased awareness and difficulty of hazardous waste disposal. Local regulations should be followed.

Non-formaldehyde disinfection products should be considered and anything containing Zinc formulas should be prohibited.

CUSTOMER ACCEPTANCE

Customer satisfaction is better with chemical recirculating toilets than with pit, vault, or regular chemical toilets. Chemical recirculating toilets are easier to keep odor free than the other types. Another reason is that the customer can flush the waste away and not see it after it goes below the flapper valve. In the past, odor has been the major complaint. New design standards given out in the 1990 "Sweet Smelling Toilet Workshops" should take care of the odor problems.

COST

For a capacity of between 850 to 1,000 uses, the cost of the Monogram Industries chemical recirculating toilets are $2,020 to $2,240 (toilet only). The new toilet designed for people with disabilities is the same price.

If the toilet is installed in a fiberglass cabana, the price including the cabana is between $2,510 to $2,780. If installed in the wood and aluminum cabana the price, including the cabana, is $2,760 to $3,060. The lower cost is based on volume purchase. Cabanas for people with disabilities will be slightly higher.

ADVANTAGES

1. Purchase and installation of chemical recirculating toilets, in either cabana, can be accomplished quickly.

2. These toilets are not restricted to a certain number of uses as long as the holding tanks are pumped as needed.

3. The small cabanas are less expensive than permanently-built buildings. However, if the chemical recirculating container is enclosed in a permanent building, it becomes more expensive than most other systems.

4. The waste mass can not be seen because of a flapper valve at the bottom of the bowl.

5. Odors can be greatly reduced and/or eliminated with proper venting.

6. Customer satisfaction is better than with pits or vaults.

DISADVANTAGES

1. Odor problems are now prevalent due to the current unsatisfactory venting techniques. Companies are beginning to change their venting designs, so odors will soon improve.

2. Disposal of the waste is difficult because treatment plant operators are cautious about receiving chemical wastes and landfills are being heavily regulated concerning the handling of hazardous waste.

3. Chemicals have to be used to protect the public and a color dye must be used to prevent the public from clearly seeing the waste particles mixed with the flushing fluid.

4. When the chemical recirculating container is installed in a small cabana, the system is subject to vandalism. The small cabana's size and the public's history of poor acceptance of these systems contributes to the vandalism problem.

5. Maintenance is frequent and maintenance personnel must receive proper training. Spare parts also need to be kept on hand.

CHEMICAL TOILETS

GENERAL DESCRIPTION

Chemical toilets are similar to chemical-recirculating toilets except that there is no flush mechanism and the user can see the waste through the seat. Also the chemical has to be added by hand, as needed.

Generally these toilets are found inside small cabanas and can be rented from any number of companies. It is nothing more than a miniature vault. Odors are usually obnoxious due to the insufficient venting associated with these cabanas.

Cabanas and chemical toilets.

Chemical toilets should ***NEVER BE USED***, except in extreme emergencies.

MAINTENANCE CHARACTERISTICS

There is generally no bowl below the seat. There is a platform with a seat and the waste simply drops into the vault below through an open hole.

The biggest maintenance problem is keeping the waste from forming a cone and keeping the overall waste level down to a depth that does not become offensive to the user.

Adding the correct amount of chemical is also a guess as there is no formula for uses versus amount.

TREATMENT OF SEWAGE

The treatment of chemical toilet waste is the same as chemical recirculating waste.

CUSTOMER ACCEPTANCE

There is no customer satisfaction with this type of toilet system. These toilets will receive more complaints than any other system.

COST

The small cabanas are usually rented and the costs vary all over the country, from around $70 to $120 a week depending on the service that goes along with the company. If the units are rented for a month or more, the price drops dramatically.

ADVANTAGES

1. The chemical toilets can be made readily available due to the vast number of rental companies all over the country. The rental companies usually pump and haul the waste away.

2. If the chemical toilets are purchased, they are the least expensive toilet system available.

3. These systems are not restricted to a certain number of uses as long as the tanks are pumped as needed.

4. This type of toilet system can be quickly made available because of the mobility of the small cabanas.

DISADVANTAGES

1. Customer satisfaction is extremely poor.

2. Odors are obnoxious due to the insufficient venting techniques found in all small cabanas.

3. Disposal of the waste is difficult because treatment plant operators are cautious about receiving chemically treated waste and landfills are becoming more conscious of hazardous waste disposal.

4. The small cabanas are easily vandalized due to their small size and poor acceptance by the public.

VAULT TOILETS

GENERAL

Vault toilets are used more than any other system in the Forest Service because of their simplicity, present economics, ability to accept unlimited use with little maintenance, and no need for electricity or water. Water may be required to precharge the vault after pumping and to maintain a water level during use so that solids do not "cone" above the water.

In the past, the design of vault buildings caused obnoxious odors to be drawn up from the vault into the building. This odor problem has caused the public and maintenance people to dislike this type of toilet system.

Square 4-unit toilet buildings with a compartment on each corner should not be used even if there is a separate vault and vent for each compartment because of the difficulty of making all compartments odorless.

Another poor aspect of vault toilets is the unsightliness of the waste when viewed down through the toilet riser. Water levels are generally not maintained and the waste piles up in a cone formation. This exposed waste promotes fly production causing further dissatisfaction from the public and maintenance people. Lighting within the building should be located to reduce the view of the vault contents.

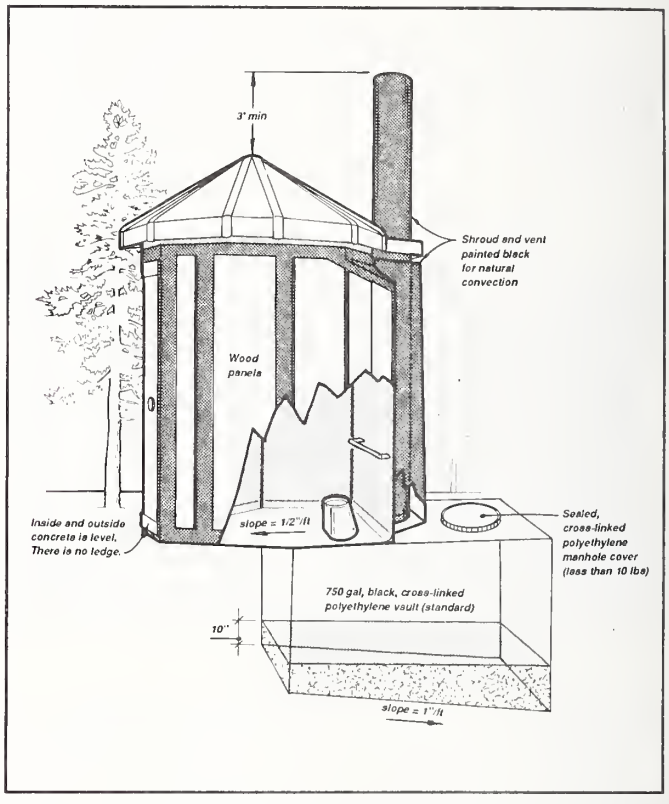
There are two major errors made in the design of vault toilet systems:

1. The venting system.
2. The placement of the building on the site.

Proper venting can be accomplished by using static methods of recently introduced Sweet Smelling Toilet (SST) standards (see photo on this page). Placement of the building must take advantage of either the wind or the sun (preferably both) for proper venting to occur.

Dynamic methods of venting can also be used such as solar or electric powered fans in conjunction with filters and/or aerated vaults. Aerated vaults result from inducing forced air uniformly into the vault so that the air mixes the waste and introduces oxygen to keep the waste in an aerobic condition.

Biological and chemical additives were tested in 1990 (27 products) and no discernible odor reduction was found. These additives are impractical, due in part to the difficulty of assuring that the additive gets evenly distributed in the waste, the constant addition of fresh waste, the handling and mixing of the various products, and the deleterious materials thrown into the vaults. However, if any manufacturer of such products can demonstrate that their products work, after trying it in an actual vault, then you may find that product to be acceptable. Leave the burden of proof up to the manufacturer.



SST Toilet System (Romtec, Inc.)

A standard Regional or Forest design is not necessarily a good idea because each individual design may not work in all areas. Designs must be flexible!

The public should be encouraged to take their throw away cans, bottles, and plastics back home for recycling.

MAINTENANCE CHARACTERISTICS

The interior of the building requires cleaning. The toilet riser requires cleaning and the vault requires pumping and cleaning.

However, there is more to the vault than just pumping. The amount of debris (cans, bottles, clothing, rocks, etc.) thrown into a vault may be enormous. This debris takes up storage space, causes the sewage pumping hose to clog, and is difficult to completely remove. Because the debris is so contaminated and smelly, it is difficult to dispose of.

Also, because of the floating nature of the cans and bottles, waste material is deposited on top of them. This causes the waste to stay above the water level, become a breeding area for flies, a raised surface for odor production, and an unpleasant sight.

The water level in vaults should be maintained above the waste level to reduce odor. When the waste forms a cone, the cone should be leveled. Periodically, the waste directly under the seat should be moved out from under the impact zone so that mounding will be reduced. This can be done with a large hoe.

Vault toilet pumping contracts should include the removal of ***all*** miscellaneous debris, and in the vaults that do not leak, the pumping contractor should be required to wash the walls of the vault and to precharge the vault with 10 in of water.

New buildings should include an outside-pumpout manhole (24 in minimum) to avoid maintenance and sanitary problems associated with pumping through the toilet riser, inside the building.

TREATMENT OF SEWAGE

The normal methods of waste disposal from a vault toilet are local-area sewage-treatment plants, lagoons, approved landfills, or treatment systems designed specifically for vault toilet waste such as a facultative lagoon. A facultative lagoon is generally 10 to 15 ft deep with a surface aerator. The waste is treated on the bottom half by anaerobic digestion and on the top half by aerobic digestion.

Treatment plant operators are reluctant to take the vault toilet waste because of its high organic content (BOD_5 = 24,000 to 26,000 ppm) which can completely upset the biological balance of their plants. The vault toilet waste is considered a hazardous waste product so the cost of pumping and disposal continues to rise.

As soon as the pumping contract requires complete removal of all the miscellaneous debris, washing down the vault walls and precharging with 10 in of fresh water, the cost will again increase.

The disposal of the debris is another problem. Cans, bottles, etc. are covered with the waste and are generally removed by a clam rake of some sort, and placed in plastic bags for removal to an approved landfill.

CUSTOMER ACCEPTANCE

The number one complaint received from the public is from the obnoxious odors and flies in vault toilet buildings. Customers dislike vault toilets!

However, if the new SST designs are followed and proper maintenance is performed, these complaints will be significantly reduced.

The vault toilet odor is an important consideration in selecting toilet facilities for the public. It is difficult to keep the buildings odor free 24 hours a day and the odor drawn out by the venting system can create obnoxious odors throughout the campground. That is why placement of the building is so important.

COST

The cost of a complete vault toilet system (single unit) ranges anywhere from $5,500 for the newly produced commercial SST design, to $15,000 for in-house Forest Service designs. *MULTIPLE UNITS ARE CONSIDERABLY MORE.*

ADVANTAGES

1. Vault toilets are fairly inexpensive.

2. They can receive unlimited use until they fill up.

3. They can be located virtually anywhere that a pumper truck has access.

4. The use can be year round with no problems during freezing weather.

5. Customer acceptance can be increased if the new SST design criteria are followed.

DISADVANTAGES

1. The unsightly nature of the waste will always be a problem.

2. Removal of the waste is a nasty job and it is becoming more expensive.

3. Disposal of the waste is becoming more difficult and costly due to stiffer regulations at treatment plants and landfills.

4. Proper design and building placement are a prerequisite to achieve acceptable odor control.

5. Proper maintenance will always be a problem because people dislike working around these systems.

6 Pumping is generally unsupervised so, in many cases, only the liquid and some solids are removed. The remaining solids and debris reduce the capacity of the holding tank and increase the odor.

7. Vandalism is common and is partially the result of the public's poor acceptance of these toilet systems.

PIT TOILETS

DESCRIPTION

Pit toilets are similar to vault toilets in every respect except that the waste drops into a hole in the ground instead of a sealed vault.

The urine leeches down through the soil and the fecal matter and toilet paper remain in the hole. Pit toilets generally create less odor than vault toilets because the fecal matter dries out (top surface only), thus forming a barrier that aids in preventing the odor from escaping. In the past, "quick-lime" was used to reduce odors. Quick-lime is not as available anymore (it is very caustic) and the addition of garden lime is not nearly as effective in reducing odors.

Pit toilets have a greater capacity than the same size vault toilet because of the liquid draining away.

Before pit toilets are designed and constructed, the designer should check with a sanitary engineer and the local regulations. Pit toilets may be appropriate in some isolated locations where pumping is impossible. Water table or nearby stream contamination is the biggest concern.

MAINTENANCE CHARACTERISTICS

Pit toilets are easier to maintain than vault toilets because the waste is never removed. Cans, bottles, etc., simply take up space and shorten the period of time that a pit can be used.

Two major differences are:

1. The fecal matter is always exposed, thus allowing flies easy access for breeding.

2. The building must be constantly moved to a new location after the pit fills up.

Cleaning of the building and toilet riser remain the same as a vault toilet.

TREATMENT OF SEWAGE

The only treatment is to cover the pit with dirt when the decision is made to move the building. Generally the dirt that is excavated from the new pit is used to cover the old pit.

CUSTOMER ACCEPTANCE

The customer acceptance of pit toilets is about the same as for vault toilets. Odors, however, are generally less. If the new SST designs are followed and proper cleaning is performed, the normal complaints will be significantly reduced.

COST

The cost is the same as a vault toilet system with the exception of the sealed vault itself. Since a pit uses only the ground, there is no cost for a vault. Some soils may have to be stabilized (shored up) so that they do not cave in after a building is constructed. This cost may make the pit toilet comparable to a sealed vault.

ADVANTAGES

1. Use is unlimited until the pit fills up.

2. They can be used in freezing weather.

3. They can accept more waste than the same size vault system.

4. They generally generate less odor than a vault.

DISADVANTAGES

1. When moving a pit toilet from hole to hole, there are only so many practical locations.

2. The fecal matter is continually exposed and this promotes fly production as well as being visually displeasing.

3. Vandalism is common due to customer dissatisfaction.

4. Odor still remains a customer complaint.

5. Maintenance personnel do not like the odor and flies and as a result proper maintenance is not performed.

6. Cans, bottles, and rocks reduce the capacity of the pit toilet.

7. Contamination of the water table is possible. Proper location will prevent this.

NOTE: Using new SST standards will help reduce numbers 3, 4, and 5.

Quick-Reference Summary

	Water-flush Toilets	Low-Volume Water-flush Toilets	Compost Toilets	Chemical Recirculating Toilets	Chemical Toilets	Vault Toilets	Pit Toilets
Description	Vitreous china or stainless steel with water trap. Flushed by gravity holding tank or pressure valve.	Designed to use less water. Models with conventional water traps suggested.	Three major producers. Two use cross-linked polyethylene and one uses fiberglass.	Usually used as temporary facilities. Uses a precharged trank with water & chemicals. Sometimes a vault is placed under building.	Generally found in small cabanas. Similar to chemical recirculating units. No flush mechanism included.	Water is contained in a sealed vault below the building. Requires pumping when nearly full.	Waste is contained in the ground below the building. No moving parts. When the pit is full the building is moved over a new hole.
Maintenance Characteristics	Parts readily available, easy to maintain. Flush valves require some training.	New 1.6 gal/flush are the same as standard flush toilets. Less than 1.0 gal/flush require spare parts because of single source purchasing.	Easy to maintain but training required. Similar to vault & pit but mixing of waste is required with occasional removal of organics & liquids.	Bowl requires more cleaning than a flush toilet. Training necessary and spare parts should be stocked.	Only maintenance is keeping the waste from mounding, adding chemicals & periodic pumping. There are no moving parts.	Maintain water level over waste. Periodically pull waste away from impact area. Pump & clean thoroughly as required. Clean building interior.	Level cone of waste in pit. Clean building interior. Move building to new location when pit fills up.
Treatment of Sewage	Septic-tank leach field, evapotranspiration bed, municipal system, on-site treatment.	Septic-tank leach field, evapotranspiration bed, municipal connection, on-site treatment holding tank & pumping.	Waste can be shallow buried or sent to an approved landfill.	Treatment & disposal are difficult due to chemical content. Treatment plant or proper landfill. Septic-tank leach field is not usually allowed.	Same as chemical recirculating toilets.	Generally pumped & taken to either a treatment plant, on-site disposal facility, or an approved landfill.	None. Simply fill hole with dirt when it is time to move the building.
Customer acceptance	Excellent by both public and maintenance personnel.	Excellent when bowls are kept clean.	Good when exhaust fans are working and facilities are clean.	Good when building compartment is vented correctly and toilet bowl is kept clean.	Very poor	Good when new-design odor control methods are used and building compartments are kept clean.	Good when new-design odor-control methods are used and building compartments are kept clean.
Cost	$100 to $200 (fixture only)	$150 to $200 (fixture only)	$4,500 to $9,650 for just the compost container. Building and housing for the compost container are extra.	$3,000 including the small cabana.	$400 to $600 to purchase. $70 to $120 per per week for rental.	$5,000 to $15,000 for a single unit.	$5,000 to $15,000 for a single unit.
Advantages	Toilet fixtures & spare parts are readily available. Reliability is excellent. Less complaints from public & employees than any other system.	Use between 0.25 & 1.6-gal water per flush. No external plumbing needed with vault. Toilets easily retrofitted. Less odors with traps.	Basically odor free due to fans & aerobic condition of waste. Good customer satisfaction. May not have to remove waste for years. Waterless system.	Purchase & installation can be completed quickly. Holding tanks can be pumped as use dictates. Waste mass cannot be seen by customer. Waterless system.	Readily available from rental companies. Lowest priced toilet system. Not restricted to number of uses as tanks are pumped as needed. Mobility. Waterless system.	Fairly inexpensive. Unlimited use until filled. Can be located anywhere with pumper access. Year-round use. SST design adds acceptance Waterless system.	Use unlimited until pit fills up. Year-round use. Accepts more waste & generates less odor than a vault.
Disadvantages	Tanks & bowls easily vandalized, but uncommon. Uses 4 to 7 gals of water. Cannot be used in freezing areas unless protected or heated.	Maintenance increased when less than 1 gal systems used. Parts inventory needed. Cannot be used in freezing areas unless protected or heated.	Waste pile is visible. Capacity restricted due to biological process degradation. Requires large housing under building. Needs liquid removal.	Odor problems prevalent. Waste disposal difficult. Chemical needed to protect public. Frequent maintenance required.	Odors obnoxious due to poor venting in small cabanas. Waste disposal difficult. Units easily vandalized.	Unsightly waste problem. Waste removal/disposal nasty, difficult, expensive. Customer & personnel acceptance poor. Pumping usually unsupervised.	Limited number of locations. Fecal matter is exposed. Odor complaints. Vandalism is common. Cans, bottles, & rocks limit capacity.

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